Paintable liquid crystal lasers with controllable lasing mechanisms

Paintable liquid crystal lasers with controllable lasing mechanisms

P.J.W. Hands, D.J. Gardiner, S.M. Morris, C.G. Mowatt, T.D. Wilkinson, H.J Coles

Department of Engineering, University of Cambridge, Cambridge, CB3 0FA, UK

Presenting author: pjwh4@cam.ac.uk

We present paintable laser sources based on emulsified dye-doped liquid crystals [1]. These simple devices are capable of emission anywhere in the visible and near-infrared, and can be coated onto arbitrary substrates without the need for alignment layers. Deswelling during drying causes liquid crystal (LC) droplets to become oblate, thus encouraging in-plane director orientation. Standing helix alignment results, which acts as an ideal cavity for band-edge lasing [2]. Furthermore, by controlling the size of LC droplets (by variation of mixing energy during emulsification), different lasing mechanisms can be realised. Emulsions with larger (10-20 µm) droplets emit by band-edge lasing, however emulsions with smaller (<5 µm) droplets display diffuse non-resonant random lasing [3]. This work provides insight into the underlying physics of lasing in complex optical media. It also enables the construction of simple, disposable laser sources, with controllable wavelength and linewidth. Applications include laser displays, optical security coatings and point-of-care medical diagnostics. We acknowledge the EPSRC for the COSMOS Basic Technology (EP/D0489X/1) and Technology Translation (EP/H046658/1) grants.

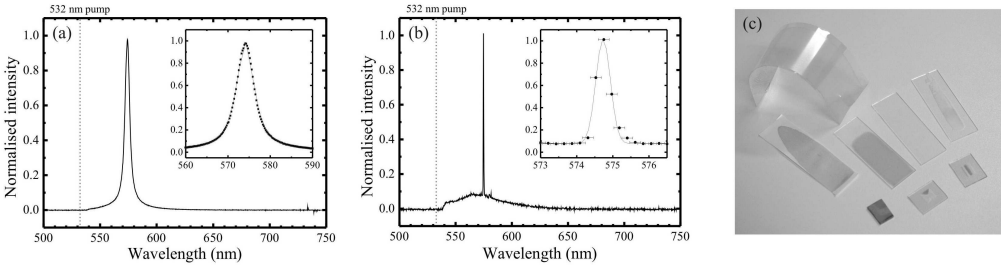

Figure 1: (a) Random lasing from small droplets, (b) band-edge lasing from large droplets, and (c) a variety of coated substrates, including glass, metal, paper and plastic.

References

1. D.J. Gardiner, et al., Opt. Express (2011) **19**, 2432
2. H.J. Coles, S.M. Morris, Nat. Photonics (2010) **4**, 676
3. P.J.W. Hands, et al., Appl. Phys. Lett. (2011) **98**, 141102